The causal effects of psychosocial well-being and emotion-driven impulsiveness on food choices of European adolescents

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Motivation

- Emotional eating is a maladaptive emotion regulation strategy
- Psychological factors play an important role in food choices
- Emotion-driven impulsiveness: Tendency to act impulsively when experiencing negative emotions:

  ↑ Unhealthy food choices
- Emotional well-being: A multidimensional composite that encompasses how positive an individual feels generally and about life overall:

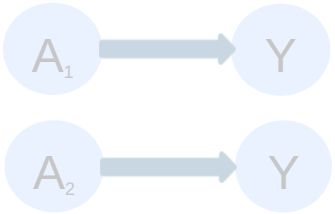
  ↑ Healthy or ↓ unhealthy food choices

Research questions

Main

(Q1) Is ↑ psychosocial well-being or ↓ emotion-driven impulsiveness more promising to improve food choices?

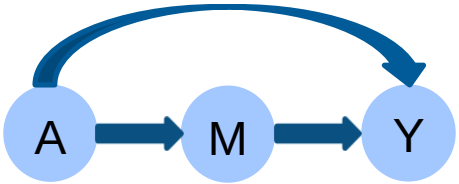
Formally, this question is asking for the separate causal effects of psychosocial well-being (A_1) and emotion-driven impulsiveness (A_2) on food choices (Y).



Additional

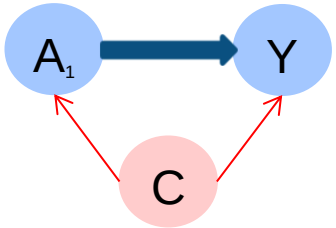
(Q2) How strong (if at all) is the effect of psychosocial well-being on adolescents' food choices mediated by emotion-driven impulsiveness?

Formally, this question is asking for the direct and indirect effects of psychosocial well-being (A) on food choices (Y) mediated by emotion-driven impulsiveness (M).

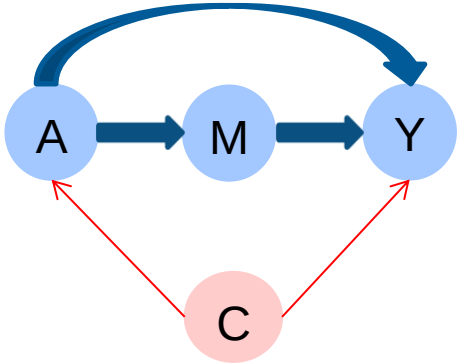


Directed Acyclic Graph (DAG)

Identify backdoor paths between...



A_1 – Psychosocial well-being
A_2 – Emotion-driven impulsiveness
Y – Sweet and fat propensity



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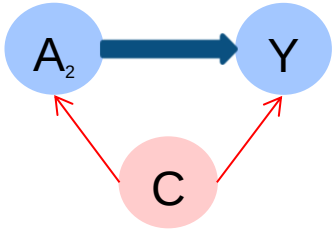

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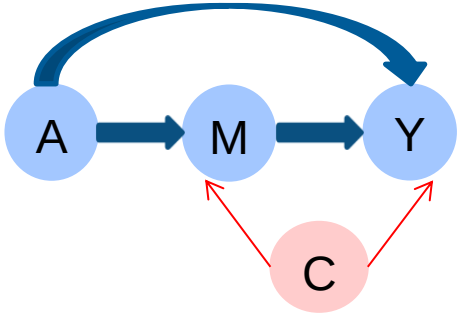

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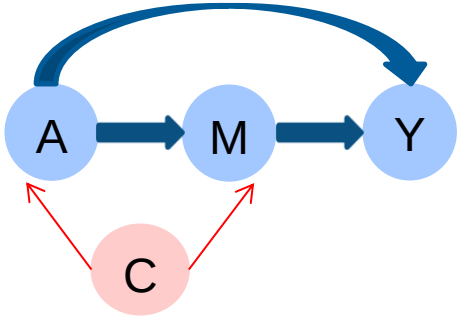

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Directed Acyclic Graph (DAG)

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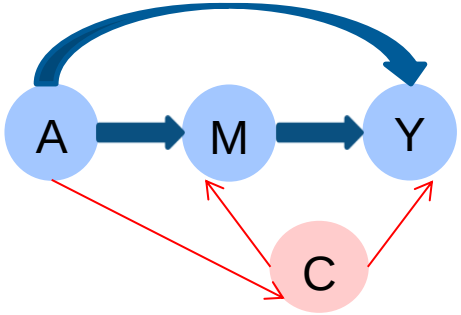
...& Identify whether exposure affects a mediator-outcome confounding variable



A – Psychosocial well-being
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DAG: Where to start?

1. Use subject-matter knowledge to identify the influences for the exposure, mediator and outcome variables

    → Consult experts, use an expert-driven framework

2. Establish causal path between each of the variables

    → Conduct literature search

3. Draw main (assumed) causal paths with variables from dataset

4. Explore different assumptions

DAG construction: Step 1 & 2

1. Check influences on **diet** within the Determinants Of Nutrition and Eating (DONE) Framework[1]

- Apply filter to population of interest: children, school-aged children
- Apply filter to level of interest: interpersonal, individual level
- Reduction of determinants: based on prioritization rounds in PEN project[2]
- Reconsideration of non-prioritized determinants based on relationship strength as displayed in the DONE Framework Web tool[3]
- Exclude determinants that are very specific to diet (e.g. food beliefs, habits, etc.)

[1]Stok FM et al. PLOS ONE. 2017;12(2):e0171077 | [2]Garnica Rosas L et al. IJBNPA. 2021;18(1):48 |
[3]https://www.uni-konstanz.de/DONE/view-interactive-data/ (Last accessed on 9 June 2023)

DAG construction: Step 1 & 2

2. Check determinants for **emotion-driven impulsiveness**

3. Check determinants for **psychosocial well-being** if associated with either food choices, emotion-driven impulsiveness or mediator-outcome confounding variable

4. Check relationships between **confounding variables**

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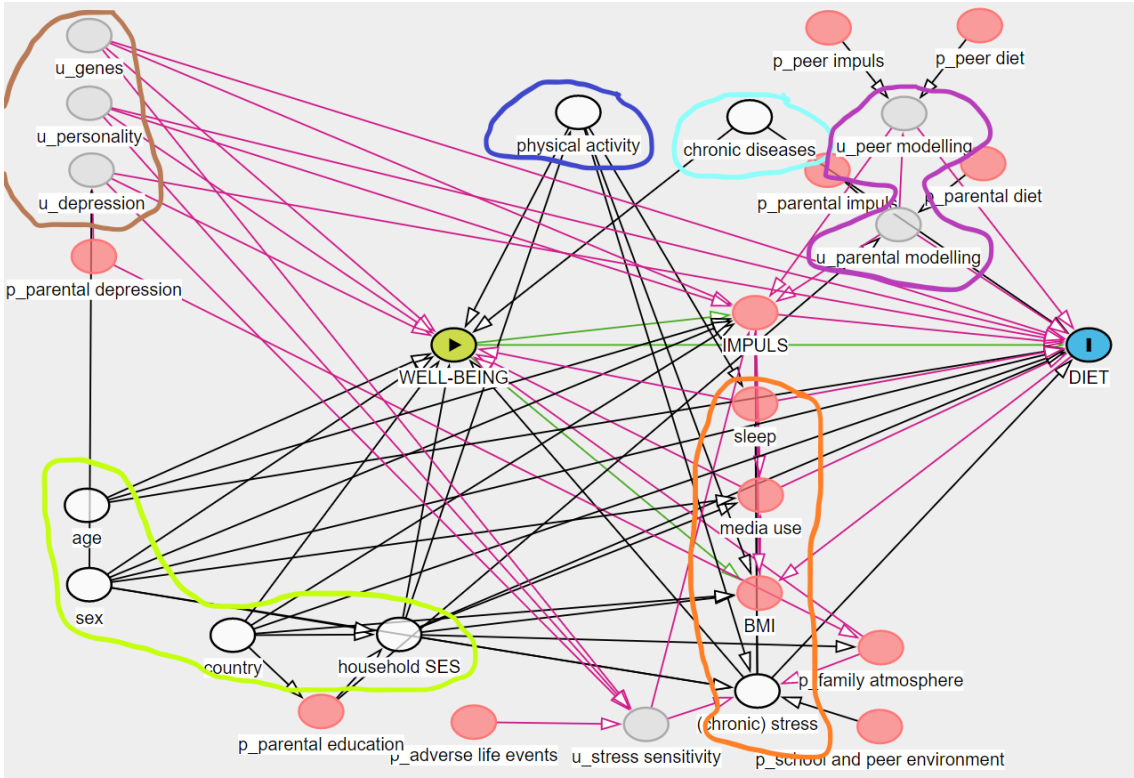


	Exposure-mediator confounding variables
	Exposure-outcome confounding variables
	Mediator-outcome confounding variables
	Exposure-mediator-outcome confounding variables
	"contextual" confounding variables
	Unmeasured without proxy (exception: depression)

DAG construction: Step 3

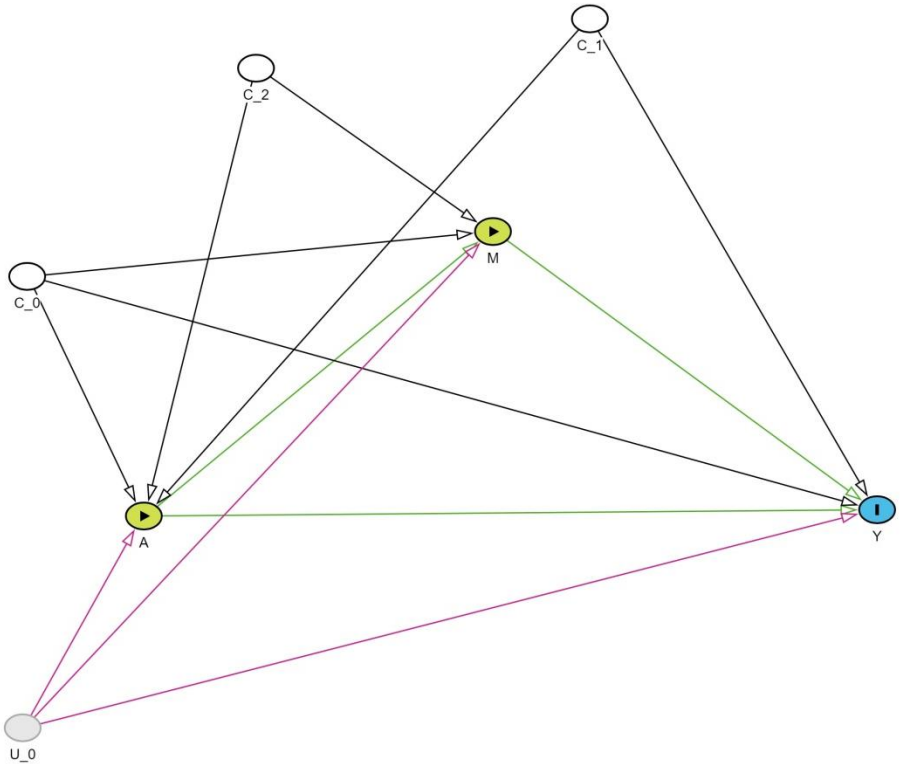
IDEFICS / I.Family Cohort

- Prospective multi-center study across 8 EU countries
- 4 Waves: 07/08, 09/10, 13/14, 20/21
- Analysis group after inclusion and exclusion criteria:

  → N = 2,065

Variables	Scale
Sweet propensity	Continuous
Fat propensity	Continuous
Emotion-driven impulsiveness	Continuous
Psychosocial well-being	Continuous
Age	Continuous
Sex	Binary
Country	Categorical
Highest educational level of parents	Binary
BMI	Continuous
Physical activity	Binary
Media use	Continuous
Sleep quality	Continuous

DAG construction: Step 3



Legend

- exposure
- outcome
- ancestor of exposure
- ancestor of outcome
- ancestor of exposure *and* outcome
- adjusted variable
- unobserved (latent)
- other variable
- causal path
- biasing path

Abbreviations*

A	psychosocial well-being (W3)
M	emotion-driven impulsiveness (W3)
Y	sweet propensity / fat propensity (W3)
C_0	age (W2), sex (W3), Country (W3), Highest educational level of parents (W2), BMI (W3), physical activity (W2), psychosocial well-being (W2), sweet propensity / fat propensity (W2)
C_1	media use (W2)
C_2	sleep quality (W2)
U_0	E.g. food availability, parental or peer modelling

*All covariates (C_0, C_1, C_2) measured at W2 were used in the main analyses except of:
- sex and country (time-fixed, i.e. unlikely to change over time) and
- BMI (assumed to affect psychosocial well-being over a short time period)

DAG construction: Step 4

Different adjustment sets which were explored...

- Health-related confounding variables derived from W3 instead of W2 that are assumed to be associated with psychosocial well-being, i.e., physical activity, sleep quality, and media use

- Sociodemographic confounding variables derived from W3 instead of W2, since a change in age and parental educational level may influence the investigated relationships in a different way

Statistical analyses (in very brief!)

Aim

- To estimate the mean difference of sweet or fat propensity that would be observed in the same individuals under hypothetical interventions ↑ psychosocial well-being or ↓ emotion-driven impulsiveness

Statistical analyses (in very brief!)

Causal inference methods

- (Q1): Combines inverse-probability-of treatment weighting with regression adjustment in a data-driven way ("**T**argeted **M**aximum **L**ikelihood **E**stimation")
- (Q2): Relies on a set of flexible models for exposure, mediator, and outcome, which are then combined to obtain the direct and mediated effects using the mediational 'g-formula' ("**C**ausal **M**ediation **A**nalysis")

→ Both methods rely on strong causal identifiability assumptions

→ Analyses are supplemented by careful & tailored sensitivity analyses

Discussion & Conclusion

- Complementing existing evidence with a causal analysis:

Comparing both psychological factors, both have weak effects, but an intervention targeting emotion-driven impulsiveness would be marginally more effective in reducing sweet and fat propensity

- Expert-driven DAG useful to
  - Visualize **assumed** data generating process
  - Communicate with co-authors about variable selection
  - Identify sources of bias to guide statistical analyses

Discussion & Conclusion

- Benefits of using causal inference methods:
  - (Q1) TMLE: Offers some degree of protection against model misspecifications (e.g. incorrect functional form)
  - (Q2): CMA: Allows interactions between the exposure and mediator

→ While (Q1) addresses a clear question: where best to intervene; Q2 is unclear what insight it actually gives into anything

- Causal inference methods (such as TMLE) with “weaker” assumptions were sufficient to answer main research question (Q1)

Thank you!

More details in the publication:
Do et al., Int J Behav Nutr Phys Act 21, 1 (2024).
https://doi.org/10.1186/s12966-023-01551-w

www.leibniz-bips.de/en

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Recent research with application of CI methods in IDEFICS/I.Family Cohort:

Börnhorst et al. (2023). Hypothetical lifestyle interventions and overweight/obesity incidence